APPLIED MATHEMATICS 10–20–30

Program of Studies

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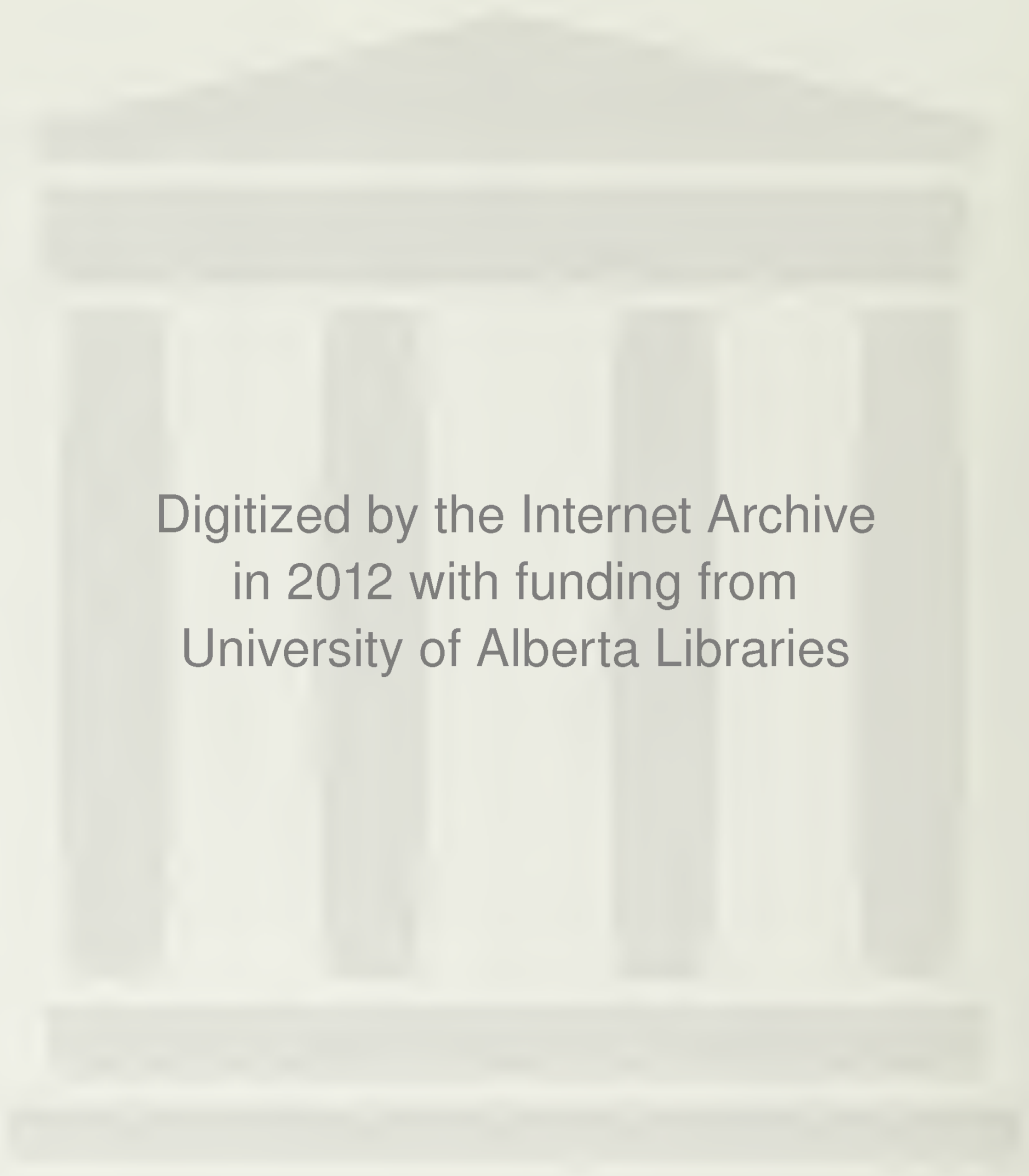
Alberta
LEARNING
Curriculum Branch



REVISED

APPLIED MATHEMATICS 10–20–30

A. PROGRAM RATIONALE AND PHILOSOPHY

Applied mathematics gives students a clearer picture of why they are learning the mathematics and motivates them in learning. Students experience mathematics as being dynamic and useful in their careers and everyday life.

The approach used in applied mathematics is primarily data driven, using numerical and geometrical problem-solving techniques. As a way of increasing relevance, students collect data in experiments and activities and develop mathematics concepts from analyses of the data. Algebraic constructs are addressed as a result of activities that students do or as a result of experiences that they are engaged in.

In applied mathematics students are required to demonstrate effective communication skills. This includes understanding, using, and interpreting various media types. Students are expected to make efficient use of both oral and written communication.

When accomplishing program or curriculum outcomes, students come to understand that mathematics is much more than theory emphasizing a set of algorithms. They learn that mathematics is a powerful set of processes, models and skills that can be used to solve nonroutine problems, both in and out of the classroom.

Applied mathematics tasks are designed to develop student flexibility and responsibility. Students show flexibility by working individually and in cooperative groups and working on nonroutine problems and projects. Students show responsibility as they work independently and explore connections among other mathematical areas, other school subjects and real-life applications. Students need support in developing flexibility and responsibility.

Technology is an integral part of applied mathematics. The graphing calculator is the primary technological tool used by students for mathematical exploration, modelling and problem solving. The use of spreadsheets, with functions defined by the student, is expected in all contexts. Technology is an effective and integral part of learning and assessment, both formative and summative, in applied mathematics.

The Applied Mathematics 10–20–30 program is made up of outcomes, some of which are common to both the applied and pure mathematics programs. The approach to the common outcomes varies from the applied to the pure programs, but the critical skill of using mathematics to find solutions to real-life situations is developed in both programs.

B. LEARNER OUTCOMES

The general outcomes for the complete Applied Mathematics 10–20–30 program are shown first. For each of the three courses, the learner outcomes follow the format of general outcomes and specific outcomes. The general outcomes are arranged in order of strand and substrand, following the order—Number, Patterns and Relations, Shape and Space, Statistics and Probability—established in the Grade 10 to Grade 12 common curriculum framework. This listing is not intended as a sequence for instruction, and the number of outcomes is not an indication of the relative times to be spent on each of the strands. The specific outcomes are arranged in the order followed in the companion documents, *Outcomes with Assessment Standards for Applied Mathematics 10*, *Outcomes with Assessment Standards for Applied Mathematics 20* and the *Diploma Examinations Bulletin for Applied Mathematics 30.*

MATHEMATICAL PROCESSES

There are critical components that students must encounter in a mathematics program in order to achieve the goals of mathematics education and to encourage lifelong learning in mathematics.

Each specific outcome incorporates one or more of these seven interrelated mathematical processes that are intended to permeate teaching and learning.

- *Communication* [C] – communicate mathematically
- *Connections* [CN] – connect mathematical ideas to other concepts in mathematics, to everyday experiences and to other disciplines
- *Estimation and Mental Mathematics* [E] – use estimation and mental mathematics where appropriate
- *Problem Solving* [PS] – relate and apply new mathematical knowledge through problem solving
- *Reasoning* [R] – reason and justify their thinking
- *Technology* [T] – select and use appropriate technologies as tools to solve problems
- *Visualization* [V] – use visualization to assist in processing information, making connections and solving problems.

GENERAL OUTCOMES—Number Strand

Substrand	Applied Mathematics 10–20–30
Number Concepts *Students will:* • use numbers to describe quantities • represent numbers in multiple ways.	Analyze the numerical data in a table for trends, patterns and interrelationships. [Applied Mathematics 10] Explain and illustrate the structure and the interrelationship of the sets of numbers within the real number system. [Applied Mathematics 10]
Number Operations *Students will:* • demonstrate an understanding of and proficiency with calculations • decide which arithmetic operation or operations can be used to solve a problem and then solve the problem.	Use basic arithmetic operations on real numbers to solve problems. [Applied Mathematics 10] Describe and apply arithmetic operations on tables to solve problems, using technology as required. [Applied Mathematics 10] Solve consumer problems, using arithmetic operations. [Applied Mathematics 20] Describe and apply operations on matrices to solve problems, using technology as required. [Applied Mathematics 30] Design or use a spreadsheet to make and justify financial decisions. [Applied Mathematics 30]

GENERAL OUTCOMES—Patterns and Relations Strand

Substrand	Applied Mathematics 10–20–30
Patterns *Students will:* • use patterns to describe the world and to solve problems.	Generate and analyze cyclic, recursive and fractal patterns. [Applied Mathematics 30]
Variables and Equations *Students will:* • represent algebraic expressions in multiple ways.	Represent and analyze situations that involve expressions, equations and inequalities. [Applied Mathematics 20] Use linear programming to solve optimization problems. [Applied Mathematics 20]
Relations and Functions *Students will:* • use algebraic and graphical models to generalize patterns, make predictions and solve problems.	Examine the nature of relations with an emphasis on functions. [Applied Mathematics 10] Represent data, using linear function models. [Applied Mathematics 10] Represent and analyze quadratic, polynomial and rational functions, using technology as appropriate. [Applied Mathematics 20]

GENERAL OUTCOMES—Shape and Space Strand

Substrand	Applied Mathematics 10–20–30
Measurement *Students will:* • describe and compare everyday phenomena, using either direct or indirect measurement.	Demonstrate an understanding of scale factors, and their interrelationship with the dimensions of similar shapes and objects. [Applied Mathematics 10 and 20] Solve problems involving triangles, including those found in 3-D and 2-D applications. [Applied Mathematics 10] Use measuring devices to make estimates and to perform calculations in solving problems. [Applied Mathematics 10 and 20] Analyze objects, shapes and processes to solve cost and design problems. [Applied Mathematics 30]
3-D Objects and 2-D Shapes *Students will:* • describe the characteristics of 3-D objects and 2-D shapes, and analyze the relationships among them.	Solve coordinate geometry problems involving lines and line segments. [Applied Mathematics 10] Develop and apply the geometric properties of circles and polygons to solve problems. [Applied Mathematics 20] Solve problems involving polygons and vectors, including both 3-D and 2-D applications. [Applied Mathematics 30]

GENERAL OUTCOMES—Statistics and Probability Strand

Substrand	Applied Mathematics 10–20–30
Data Analysis *Students will:* • collect, display and analyze data to make predictions about a population.	Apply line-fitting and correlation techniques to analyze experimental results. [Applied Mathematics 10] Analyze graphs or charts of given situations to derive specific information. [Applied Mathematics 20]
Chance and Uncertainty *Students will:* • use experimental or theoretical probability to represent and solve problems involving uncertainty.	Use normal and binomial probability distributions to solve problems involving uncertainty. [Applied Mathematics 30] Solve problems based on the counting of sets, using techniques such as the fundamental counting principle, permutations and combinations. [Applied Mathematics 30] Model the probability of a compound event, and solve problems based on the combining of simpler probabilities. [Applied Mathematics 30]

Topic 1: Measurement

C	Communication	PS	Problem Solving
CN	Connections	R	Reasoning
E	Estimation and Mental Mathematics	T	Technology
		V	Visualization

General and Specific Outcomes	
General Outcomes	**Specific Outcomes**
Use measuring devices to make estimates and to perform calculations in solving problems.	Outcomes 1.1 to 1.6 are exclusive to Applied Mathematics 10. 1.1 Select and apply appropriate instruments, units of measure (in SI and Imperial systems) and measurement strategies to find lengths, areas and volumes. [E, PS, T] 1.2 Analyze the limitations of measuring instruments and measurement strategies, using the concepts of precision and accuracy. [C, R] 1.3 Solve problems involving length, area, volume, time, mass and rates derived from these. [C, E, PS] 1.4 Interpret drawings, and use the information to solve problems. [C, PS, V]
Demonstrate an understanding of scale factors, and their interrelationship with the dimensions of similar shapes and objects.	1.5 Calculate the volume and surface area of a sphere, using formulas that are provided; e.g., $SA = 4\pi r^2$, $V = \frac{4}{3}\pi r^3$. [CN, PS, V] 1.6 Determine the relationships among linear scale factors, areas, the surface areas and the volumes of similar figures and objects; e.g., surface area to volume ratios. [CN, PS, R, V]

C	Communication	**PS**	Problem Solving
CN	Connections	**R**	Reasoning
E	Estimation and Mental Mathematics	**T**	Technology
		V	Visualization

Topic 2: Number Patterns in Tables

General and Specific Outcomes	
General Outcomes	**Specific Outcomes**
Analyze the numerical data in a table for trends, patterns and interrelationships.	Outcomes 2.1 to 2.8 are common to Pure Mathematics 10. Outcome 2.9 is exclusive to Applied Mathematics 10. 2.1 Use words and algebraic expressions to describe the data and the interrelationships in a table with rows that are not related recursively (not calculated from previous data). **Note**: Algebraic expressions can include expressions that use variables and expressions that describe formulas from spreadsheets. [C, CN] 2.2 Use words and algebraic expressions to describe the data and the interrelationships in a table with rows that are related recursively (calculated from previous data). [C, CN]
Explain and illustrate the structure and the interrelationship of the sets of numbers within the real number system.	2.3 Classify numbers as natural, whole, integer, rational or irrational, and show that these number sets are nested within the real number system. [C, R, V] 2.4 Use approximate representations of irrational numbers. [R, T]
Use basic arithmetic operations on real numbers to solve problems.	2.5 Communicate a set of instructions used to solve an arithmetic problem; e.g., communicate instructions that follow the algebraic format of the formula. [C] 2.6 Perform arithmetic operations on irrational numbers, using appropriate decimal approximations. [E, T]

(continued)

Topic 2: Number Patterns in Tables

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General and Specific Outcomes	
General Outcomes	**Specific Outcomes**
Describe and apply arithmetic operations on tables to solve problems, using technology as required.	2.7 Create and modify tables from both recursive and nonrecursive situations. [PS, T, V] 2.8 Use and modify a spreadsheet template to model recursive situations. [PS, T, V] 2.9 Solve problems involving combinations of tables, using: • addition or subtraction of two tables • multiplication of a table by a real number • algebraic processes to build spreadsheet functions and templates. [PS, T, V]

Topic 3: Relations and Functions

General and Specific Outcomes	
General Outcome	**Specific Outcomes**
Examine the nature of relations with an emphasis on functions.	Outcomes 3.1 to 3.6 are common to Pure Mathematics 10. 3.1 Plot linear and nonlinear data, using appropriate scales. [C, V] 3.2 Represent data, using function models. [CN, PS, V] 3.3 Use a graphing tool to draw the graph of a function from its equation; e.g., A thrown object context uses formula $h = -4.9t^2 + 6t + 10$ to describe its path. [C, T, V] 3.4 Describe a function in terms of: • ordered pairs • a rule, in word or equation form; e.g., cost of publishing a \$20 book with an initial cost of \$2000 could be represented by the formula $C = 20n + 2000$ • a graph. [C, CN, V] 3.5 Use function notation to evaluate and represent functions, using contextually appropriate variables; e.g., use volume as a function of time in the form $V = v(t)$ rather than $y = f(x)$. [C, PS] 3.6 Determine the domain and range of a relation from its graph. [PS, V]

Topic 4: Line Segments

General and Specific Outcomes	
General Outcome	**Specific Outcomes**
Solve coordinate geometry problems involving lines and line segments.	Outcomes 4.1 to 4.4 are common to Pure Mathematics 10. 4.1 Solve problems involving distances between points in the coordinate plane; e.g., the use of the distance formula $\overline{AB} = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$ [PS, V] 4.2 Solve problems involving midpoints of line segments; e.g., midpoint formula $\left(\frac{x_1 + x_2}{2}, \frac{y_1 + y_2}{2}\right)$ can be used. [PS] 4.3 Solve problems involving rise, run and slope of line segments; e.g., $m(\overline{AB}) = \frac{y_2 - y_1}{x_2 - x_1}$ can be used. [PS, V] 4.4 Solve problems using slopes of: • parallel lines • perpendicular lines. [CN, PS, V]

Topic 5: Linear Functions

General and Specific Outcomes	
General Outcomes	**Specific Outcomes**
Examine the nature of relations with an emphasis on functions.	Outcomes 5.1 and 5.5 to 5.9 are exclusive to Applied Mathematics 10. Outcomes 5.2 to 5.4 are common to Pure Mathematics 10. 5.1 Rewrite linear expressions in terms of the dependent (responding) variable. [C, R, V] 5.2 Determine the following characteristics of the graph of a linear function, given its equation in any of the forms $y = mx + b$, $y - y_1 = m(x - x_1)$, $Ax + By + C = 0$, $Ax + By = C$: • intercepts • slope • domain • range. [PS, V] 5.3 Determine the equation of a line, given information that uniquely determines the line. [PS, V]
Represent data, using linear function models.	5.4 Use variation and arithmetic sequences as applications of linear functions. (Use of algebraic and technological means is appropriate.) [CN, PS, V]

(continued)

Topic 5: Linear Functions

(continued)

General and Specific Outcomes	
General Outcomes	**Specific Outcomes**
Apply line-fitting and correlation techniques to analyze experimental results.	5.5 Determine the equation of a line of best fit, using: • estimate of slope and one point • median–median method • least squares method with technology. [CN, PS, T, V] 5.6 Use best-fit linear equations and their associated graphs to make predictions and solve problems. [C, CN, PS, T, V] 5.7 Explain the significance of the parameters a and b in the best-fit equation $y = ax + b$. [C, CN, R, V] 5.8 Use technological devices to determine the correlation coefficient r. [T] 5.9 Interpret the correlation coefficient r and its limitations for varying problem situations, using relevant scatterplots. [C, R, V]

C	Communication	**PS**	Problem Solving
CN	Connections	**R**	Reasoning
E	Estimation and Mental Mathematics	**T**	Technology
		V	Visualization

Topic 6: Trigonometry

General and Specific Outcomes	
General Outcome	**Specific Outcomes**
Solve problems involving triangles, including those found in 3-D and 2-D applications.	Outcomes 6.1 to 6.3 are common to Pure Mathematics 10. 6.1 Solve problems involving two right triangles. [CN, PS, V] 6.2 Extend the concepts of sine and cosine for angles from 0° to 180°. [R, T, V] 6.3 Apply the sine and cosine laws, excluding the ambiguous case, to solve problems; e.g., Cosine Law: $\cos A = \frac{b^2 + c^2 - a^2}{2bc}$. [CN, PS, V]

Topic 1: Graphing and Design

C	Communication	**PS**	Problem Solving
CN	Connections	**R**	Reasoning
E	Estimation and Mental Mathematics	**T**	Technology
		V	Visualization

General and Specific Outcomes	
General Outcome	**Specific Outcomes**
Analyze graphs or charts of given situations to derive specific information.	Outcomes 1.1 to 1.3 are exclusive to Applied Mathematics 20. 1.1 Extract information from given graphs of discrete or continuous data, using: • time series • glyphs (custom pictorial representations) • continuous data • contour lines. [C, CN, E, PS, R, V] 1.2 Draw and validate inferences, including interpolations and extrapolations, from graphical and tabular data. [CN, E, PS, V] 1.3 Design different ways of presenting data and analyzing results, by focusing on the truthful display of data and the clarity of presentation. [C, CN, T, V]

C	Communication	**PS**	Problem Solving
CN	Connections	**R**	Reasoning
E	Estimation and Mental Mathematics	**T**	Technology
		V	Visualization

Topic 2: Regression and Nonlinear Equations

General and Specific Outcomes	
General Outcomes	**Specific Outcomes**
Represent and analyze situations that involve expressions, equations and inequalities.	Outcomes 2.1 and 2.2 are common to Pure Mathematics 20. Outcomes 2.3 to 2.5 are exclusive to Applied Mathematics 20. 2.1 Solve nonlinear equations, using a graphing tool (intent is to solve nonlinear equations not systems of nonlinear equations). [CN, T, V]
Represent and analyze quadratic, polynomial and rational functions, using technology as appropriate.	2.2 Determine the following characteristics of the graph of a quadratic function; e.g., $f(x) = x^2 + 6x + 4$: • vertex • domain and range • axis of symmetry • intercepts. [C, PS, T, V]
Analyze graphs or charts of given situations to derive specific information.	2.3 Collect experimental data; graph the data using technology and represent the data with best-fit exponential or quadratic functions of the form: • $y = ab^x$ • $y = ax^2 + bx + c$. [C, CN, PS, T, V] 2.4 Use best-fit exponential and quadratic functions and their associated graphs to make predictions and solve problems. [C, CN, PS, T, V] 2.5 Explain the significance of the parameters in the equations for exponential and quadratic functions of the form: • $y = ab^x \rightarrow$ parameters a, b • $y = ax^2 + bx + c \rightarrow$ parameters a, c. [C, CN, R, V]

C	Communication	**PS**	Problem Solving
CN	Connections	**R**	Reasoning
E	Estimation and Mental Mathematics	**T**	Technology
		V	Visualization

Topic 3: Linear Systems and Programming

General and Specific Outcomes	
General Outcomes	**Specific Outcomes**
Represent and analyze situations that involve expressions, equations and inequalities.	Outcomes 3.1 and 3.2 are common to Pure Mathematics 20. Outcomes 3.3 to 3.6 are exclusive to Applied Mathematics 20. 3.1 Graph linear inequalities in two variables; e.g., $Ax + By + C = 0$ converted to $y =$ form is a necessary preliminary step. [PS, V] 3.2 Solve systems of linear equations, in two variables: • algebraically (elimination and substitution) • graphically. [CN, PS, T, V]
Use linear programming to solve optimization problems.	3.3 Use expressions containing variables to describe problem contexts and solutions. [C, CN, PS, R] 3.4 Solve, graphically, systems of linear inequalities, in two variables, using technology. [CN, PS, T, V] 3.5 Design and solve linear and nonlinear systems, in two variables, to model problem situations. [C, CN, PS, R, V] 3.6 Apply linear programming to find optimal solutions to decision-making problems. [C, PS, R, T, V]

C	Communication	**PS**	Problem Solving
CN	Connections	**R**	Reasoning
E	Estimation and Mental Mathematics	**T**	Technology
		V	Visualization

Topic 4: Finance

General and Specific Outcomes	
General Outcome	**Specific Outcomes**
Solve consumer problems, using arithmetic operations.	Outcomes 4.1 to 4.4 are common to Pure Mathematics 20. 4.1 Solve consumer problems, including: • wages earned in various situations • property taxation • exchange rates • unit prices. [CN, E, PS, R, T] 4.2 Reconcile financial statements, including: • cheque books with bank statements • cash register tallies with daily receipts. [CN, PS, T] 4.3 Solve budget problems, using graphs and tables to communicate solutions. [C, PS, T, V] 4.4 Solve investment and credit problems involving simple and compound interest; e.g., $I = prt$ (simple) and $A = P(1 + i)^n$ (compound). [CN, PS, T]

C	Communication	**PS**	Problem Solving
CN	Connections	**R**	Reasoning
E	Estimation and Mental Mathematics	**T**	Technology
		V	Visualization

Topic 5: Circle Geometry and Design

General and Specific Outcomes	
General Outcome	**Specific Outcomes**
Develop and apply the geometric properties of circles and polygons to solve problems.	Outcome 5.1 is common to Pure Mathematics 20. Outcome 5.2 is exclusive to Applied Mathematics 20. 5.1 Use technology and measurement to confirm and apply the following properties to particular cases: • the perpendicular from the centre of a circle to a chord bisects the chord • the measure of the central angle is equal to twice the measure of the inscribed angle subtended by the same arc • the inscribed angles subtended by the same arc are congruent • the angle inscribed in a semicircle is a right angle • the opposite angles of a cyclic quadrilateral are supplementary • a tangent to a circle is perpendicular to the radius at the point of tangency • the tangent segments to a circle, from any external point, are congruent • the sum of the interior angles of an n-sided polygon is $(2n - 4)$ right angles. [PS, R, T, V] 5.2 Use properties of circles and polygons to solve design and layout problems. [CN, PS, V]

C	Communication	**PS**	Problem Solving
CN	Connections	**R**	Reasoning
E	Estimation and Mental Mathematics	**T**	Technology
		V	Visualization

Topic 6: Measurement and Design

General and Specific Outcomes	
General Outcomes	**Specific Outcomes**
Demonstrate an understanding of scale factors, and their interrelationship with the dimensions of similar shapes and objects	Outcomes 6.1 to 6.4 are exclusive to Applied Mathematics 20. 6.1 Enlarge or reduce a dimensioned object, according to a specified scale (proportion and ratio competency is a requirement). [C, CN, PS, V]
Use measuring devices to make estimates and to perform calculations in solving problems.	6.2 Calculate maximum and minimum values, using tolerances, for lengths, areas and volumes. [PS, R, V] 6.3 Solve problems involving percentage error when input variables are expressed with percentage errors (students can use formulas or first principles). [PS, R, V] 6.4 Design an appropriate measuring process or device to solve a problem. [E, PS, V]

APPLIED MATHEMATICS 30

Topic 1: Matrices and Pathways

C	Communication	**PS**	Problem Solving
CN	Connections	**R**	Reasoning
E	Estimation and Mental Mathematics	**T**	Technology
		V	Visualization

General and Specific Outcomes	
General Outcomes	**Specific Outcomes**
Solve problems based on the counting of sets, using techniques such as the fundamental counting principle, permutations and combinations.	Outcomes 1.1 and 1.2 are common to Pure Mathematics 30. Outcome 1.3 is new to Applied Mathematics 30. Outcome 1.4 is exclusive to Applied Mathematics 30. 1.1 Solve pathway problems, interpreting and applying any constraints. [PS, R] 1.2 Use the fundamental counting principle to determine the number of different ways to perform multistep operations. [PS, R]
Describe and apply operations on matrices to solve problems, using technology as required.	1.3 Perform, using technology only for larger matrices, the matrix operations of addition, subtraction, matrix multiplication and multiplication by a scalar. [C, E, R, T, V] 1.4 Model and solve consumer and network problems, performing matrix operations and using algebraic solution strategies as needed. [CN, PS, T, V]

Topic 2: Statistics and Probability

General and Specific Outcomes	
General Outcomes	**Specific Outcomes**
Use normal and binomial probability distributions to solve problems involving uncertainty.	Outcomes 2.1 to 2.5, and 2.7 are common to Pure Mathematics 30. Outcome 2.6 is similar to an outcome in Pure Mathematics 30. 2.1 Find the population standard deviation of a data set or a probability distribution, using technology; e.g., $\sigma = \sqrt{\frac{\sum_{i=1}^{i=n}(x_i - \mu)^2}{n}}$. [CN, E, T, V] 2.2 Use z-scores and the normal distribution to solve problems; e.g., $z = \frac{x - \mu}{\sigma}$. [PS, R, T, V] 2.3 Use the normal approximation to the binomial distribution to solve problems involving confidence intervals for large samples. [CN, E, PS, T]
Model the probability of a compound event, and solve problems based on the combining of simpler probabilities.	2.4 Construct a sample space for two or three events. [PS, R, V] 2.5 Classify events as independent or dependent. [C] 2.6 Use expressions for $P(A \text{ and } B)$ to solve problems involving independent and dependent events. [CN, PS, R] 2.7 Solve problems, using the probabilities of mutually exclusive and complementary events. [CN, PS, R]

C	Communication	**PS**	Problem Solving
CN	Connections	**R**	Reasoning
E	Estimation and Mental Mathematics	**T**	Technology
		V	Visualization

Topic 3: Finance

General and Specific Outcomes	
General Outcome	**Specific Outcomes**
Design or use a spreadsheet to make and justify financial decisions.	Outcomes 3.1 to 3.4 are exclusive to Applied Mathematics 30. 3.1 Design a financial spreadsheet template to allow users to input their own variables. [C, PS, T] 3.2 Analyze the costs and benefits of renting or buying an increasing asset; e.g., home, under different circumstances. **Note**: Outcomes 3.2 and 3.3 requires students to build their own spreadsheets. This building process requires the application of algebraic structures. [C, CN, PS, T] 3.3 Analyze the costs and benefits of leasing or buying a decreasing asset; e.g., vehicle, computer, under different circumstances. [C, CN, PS, T] 3.4 Analyze an investment portfolio applying such concepts as interest rate, rate of return and total return. [C, CN, PS, T]

C	Communication	PS	Problem Solving
CN	Connections	R	Reasoning
E	Estimation and Mental Mathematics	T	Technology
		V	Visualization

Topic 4: Cyclic, Recursive and Fractal Patterns

General and Specific Outcomes	
General Outcome	**Specific Outcomes**
Generate and analyze cyclic, recursive and fractal patterns.	Outcomes 4.1 to 4.6 are exclusively in Applied Mathematics 30 although 4.1 and 4.3 are closely related to outcomes in Pure Mathematics 30. 4.1 Collect sinusoidal data; graph the data using technology, and represent the data with a best fit equation of the form: • $y = a \sin(bx + c) + d$. [C, CN, PS, T, V] 4.2 Use best fit sinusoidal equations, and their associated graphs, to make predictions (interpolation, extrapolation). [C, CN, PS, T] 4.3 Describe periodic events, including those represented by sinusoidal curves, using the terms amplitude, period, maximum and minimum values, vertical and horizontal shift (connect parameters of a, b, c and d with real-life examples illustrated in 4.3). [C, V] 4.4 Use technology to generate and graph sequences that model real-life phenomena. [PS, T, V] 4.5 Use technology to construct a fractal pattern by repeatedly applying a procedure to a geometric figure. [CN, R, V, T] 4.6 Use the concept of self-similarity to compare and/or predict the perimeters, areas and volumes of fractal patterns. [CN, R, T, V]

C	Communication	**PS**	Problem Solving
CN	Connections	**R**	Reasoning
E	Estimation and Mental Mathematics	**T**	Technology
		V	Visualization

Topic 5: Vectors

General and Specific Outcomes	
General Outcome	**Specific Outcomes**
Solve problems involving polygons and vectors, including both 3-D and 2-D applications.	The standards statements include the correspondence between Topic 5 of Applied Mathematics 30 with the vectors section of Physics 20. 5.1 Use appropriate terminology to describe: • vectors; i.e., magnitude, direction • scalar quantities; i.e., magnitude. [C, CN] 5.2 Assign meaning to the multiplication of a vector by a scalar. [CN] 5.3 Determine the magnitude and direction of a resultant vector, using triangle or parallelogram methods. [CN, R, T, V] 5.4 Model and solve problems in 2-D and simple 3-D, using vector diagrams and technology. [CN, PS, T, V]

C	Communication	**PS**	Problem Solving
CN	Connections	**R**	Reasoning
E	Estimation and Mental Mathematics	**T**	Technology
		V	Visualization

Topic 6: Design

General and Specific Outcomes	
General Outcome	**Specific Outcomes**
Analyze objects, shapes and processes to solve cost and design problems.	Outcomes 6.1 to 6.4 are exclusive to Applied Mathematics 30. 6.1 Use dimensions and unit prices to solve problems involving perimeter, area and volume. [E, PS, V] 6.2 Solve problems involving estimation and costing for objects, shapes or processes when a design is given. [C, E, PS] 6.3 Design an object, shape, layout or process within a specified budget. (Any design process requires defining variables and linking input and output variables. These are algebraic procedures.) [PS, R, V] 6.4 Use mathematical models to estimate the solutions to complex measurement problems. [E, V]